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JT-60U におけるトロイダル回転分布のコア部熱輸送に対する影響の数値解析
Simulation studies of roles of toroidal rotation profiles on core heat transport in JT-60U

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It has been reported that in H-mode plasmas, toroidal rotation in the co direction with respect to the plasma current is more favorable for energy confinement than that in the counter direction. Effects of toroidal rotation on core temperature profiles have been pointed out, whereas the improved confinement has been found to be due to an increase in the pedestal temperature with co-toroidal rotation and profile resilience [1]. In JT-60U, the better electron-temperature ($T_{\rm e}$) ITB with co-toroidal rotation has been observed. The $T_{\rm e}$ and ion temperature $T_{\rm i}$ profiles are shown in Fig. 1(a). The radial electric field E_r shear is similar to that of the plasma with counter(ctr)-toroidal rotation, and the power deposition profiles are forced to be identical [2].

In this study, core heat transport of these plasmas with different toroidal rotation profiles is investigated with several transport models implemented in the transport code TOPICS [3] and the flux-tube gyrokinetic code GS2[4]. In TOPICS simulations, transport models give the anomalous heat diffusivity, and the temperature is calculated. The calculations are performed with effects of E_r shear. Transport models predict similar temperature profiles to that of experiments in the outside ITB region. However, the difference in $T_{\rm e}$ profile between co- and ctr-rotation cases observed in the experiments is not shown. Next, GS2 linear calculations are performed with and without the flow shear effects. The flow shear is defined as $\gamma_{E\times B} = \frac{\rho}{q}\frac{d\omega(\psi)}{d\rho}$, where $\omega(\psi)$ is the toroidal angular frequency, $\omega(\psi) = -\frac{d\Phi}{d\psi} - \frac{1}{n_{\rm i}e}\frac{dp_{\rm i}}{d\psi}$. In calculations, the parallel flow shear is accounted. The effective linear growth rates $\gamma*$ are calculated for co- and ctr-rotation cases in the same manner as [5]. As shown in Fig. 1(b), when the flow shear effects are included in calculations, the large discrepancy in the growth rate between the two cases is observed around $\rho = 0.5$. The profile of the flow shear is shown in Fig. 1(c). The low flow shear around $\rho = 0.5$ for the ctr-rotation case causes the discrepancy in the growth rate. The difference in results from TOPICS and GS2 will be discussed in the paper.

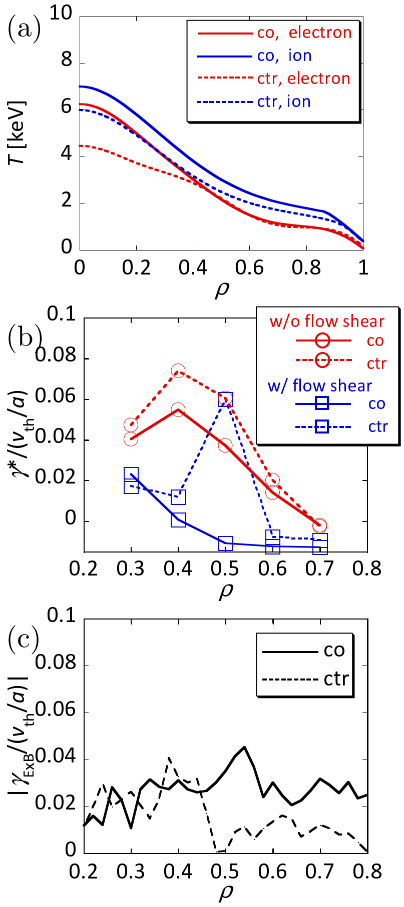

Fig. 1 Comparison of profiles between co- and ctr-rotation cases for (a) The $T_{\rm e}$ and $T_{\rm i}$ profiles; (b) The $\gamma*$ profiles from GS2; (c) The $\gamma_{E\times B}$ profiles used in GS2 calculations.

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